

cinerascens), Crissal Thrasher (*Toxostoma crissale*), Yellow-breasted Chat (*Icteria virens*), Osprey (*Pandion haliaeetus*), and Black-chinned Hummingbird (*Archilochus alexandri*). Interesting records that are rare throughout the region during breeding season included an Inca Dove (*Columbina inca*), a Bronzed Cowbird (*Molothrus aenus*), and four Yellow-billed Cuckoos (*Coccyzus americanus*).

4.2.2.2 Distribution and habitat patterns

The percent cover of riparian trees is higher closer to Presa Morelos, and decreases as distance from the dam increases, in particular with willows ($r^2 = 0.53$, $t = 9.51$, $p < 0.001$), but also with cottonwoods ($r^2 = 0.24$, $t = 5.24$, $p = 0.0069$). The distribution of species richness and total bird abundance also follow the same pattern, being an increase in the coverage of willows the principal habitat feature determining increases in species richness ($r^2 = 0.32$, $t = 3.60$, $p = 0.0013$) and bird abundance ($r^2 = 0.25$, $t = 3.01$, $p = 0.0056$). The distribution of saltcedar, shrubs, and open water was continuous throughout the Limitrophe Zone.

4.2.2.3 Mist Netting

We banded and processed 21 birds from 11 species. The capture rate was low (0.65 birds per net per day), probably because the high temperatures were limiting the activities of birds, and because it was difficult to conceal the nets at all potential sites, due to safety considerations. Nevertheless, this activity allowed us to document breeding activity of 9 species (by the presence of Hatch Year birds, presence of brood patch, or cloacal protuberance), including Abert's Towhees, Black-chinned Hummingbird, Blue Grosbeak, Cactus Wren, Common Yellowthroat, Common Ground-Dove, House Finch, Ladder-backed Woodpecker, and Verdin.

4.2.2.4 Call-response surveys

We failed to detect responses from Willow Flycatchers and Bell's Vireos. The probability to elicit a response of these two species was probably higher early in the season, however, it is likely that both species are absent or very rare in the Limitrophe Zone. R. Ericsson detected a singing Bell's Vireo male in an agricultural drain about 7 km west of Morelos Dam, in an area

dominated by Palo Verde and Mesquite on July 9 (same day in which we were conducting our surveys). These shows that at least Bell's Vireos in the region were singing and detectable.

We detected 6 singing Yellow-billed Cuckoos along the Limitrophe. All of them were nearby the main stem of the river, and in areas dominated by tall (>5m) willows and cottonwoods. The cuckoos were distributed in the northern half of the study area. Three of them were detected at areas in which the only riparian tree was willow. This is the highest number of Yellow-billed Cuckoo detections in the Colorado River in Mexico, and is the fourth consecutive year in which we have detected cuckoos in the Mexican portion of the river. It is likely that Yellow-billed Cuckoos have established again in the river in response to the restoration of native riparian vegetation and a continuous instream flow, and there is probable a modest population.

4.2.2.5 Yuma Clapper Rail Surveys

The Non-Game Department of Arizona Game and Fish, Yuma Office, has conducted Yuma Clapper Rail surveys along the U.S. portion of the Limitrophe Zone since 1981, although not continuously. In the years they surveyed, they detected 3 rails at Hunter's Hole in 2002, 0 in 1999, and 4 in 1997. The maximum number they have detected is 11, in 1983. This suggests that modest instream flows can maintain habitat for Yuma Clapper Rails in the Limitrophe Zone.

4.2.2.6 Linden Piest (Arizona Game and Fish Department) Field Notes

Lin Piest is the Non-Game Specialist at the Yuma Office of Arizona Game and Fish. He has conducted surveys for Willow Flycatchers and Yuma Clapper Rails along the Limitrophe Zone. He provided us with his field notes. Some of the noteworthy information includes two Summer Tanagers close to Presa Morelos on June 22, 2000 and several records of Yellow-billed Cuckoos: 2 on June 1999, 1 on July 2000, 3 on July 2001, and 1 on July 2002.

4.2.2.7 Annotated Checklist

An annotated checklist of the birds of the Limitrophe Zone of the Colorado River was compiled using the data collected during field work plus other sources of information, including

field notes from the authors and from other ornithologists that have visited the area. The checklist is in Appendix I.

4.2.3 Amphibians

We only documented the presence of Woodhouse's toad (*Bufo woodhousii*). The area is within the distribution of several species of amphibians, including the Colorado River toad (*Bufo alvarius*) and lowland leopard frog (*Rana yavapaiensis*) which are considered species of special concern in the U.S. The second of these is on the Mexican list of species at risk. The Colorado River toad has its main habitat in permanent streams, which unfortunately, in the area, are occupied by the bull frog (*Rana catesbeiana*), a voracious, introduced species. It is likely that modification of river conditions along with the introduction of this species as well as alien fish and soft-shelled turtles have caused the extirpation of native amphibians from the area, or, at least, severely impaired their populations (Mellink and Ferreira-Bartrina 2000), including that of the Colorado River toad.

4.2.4 Reptiles

We documented the following species of reptiles:

- Soft-shelled turtle (*Trionyx spinifera*). The soft-shelled turtle, alien to this region, has been a long time resident of the Colorado river delta (Mellink and Ferreira-Bartrina 2000). This was the only turtle recorded in the river.
- Side-blotched lizard (*Uta stansburiana*). Very common in the understory at Pachuca 1.
- Tree lizard (*Urosaurus ornatus*). This lizard is an arboreal riparian specialist that has become scarce as the riparian corridors of the region have deteriorated. Although not at risk, the species might offer an argument for the protection of the area.
- Desert spiny lizard (*Sceloporus magister*). We captured a male of the subspecies of the eastern side of the Colorado River (*S. m. magister*), and must have colonized the area west of it in recent time. No other individuals of the species were seen.
- Whiptail (*Cnemidophorus tigris*). A few seen at Pachuca 1.

- Bullsnake (*Pituophis melanoleucus*). Likely track and road-kill in Pachuca 1.

By using a freshwater turtle trap we were hoping to find the Sonora mud-turtle (*Kinosternon sonoriensis*), which has been recorded in the U.S. part of the river, but not in the Mexican part. This is a sensitive species. No turtles were caught, nor seen, on the Pachuca stretch of river.

Two species that were historically found along the river but were absent from our sampling are the flat-tailed horned-lizard (*Prhynosoma mcallii*) and the Colorado Desert fringe-toed lizard (*Uma notata*). The patches of open sand are probably too small for these species.

4.2.5 Mammals

We documented:

- Cottontail (*Sylvilagus audubonii*). Common at Pachuca 1 and 2 (individuals, tracks, scats).
- Pygmy pocket gopher (*Thomomys umbrinus*). Mounds at Presa Morclos and an agricultural plot near Pachuca 1.
- Desert pocket mouse (*Chaetodipus penicillatus*). 10 at Pachuca 1 and 2, including 4 juveniles.
- Merriam's kangaroo rat (*Dipodomys merriami*). Two individuals at Pachuca 1 (inactive female, and juvenile male).
- Deer mouse (*Peromyscus maniculatus*). One at Pachuca 2.
- Muskrat (*Ondatra zibethicus*). The species, although on the Mexican list of species at risk, is common throughout the Mexicali Valley (Mellink 1995, Mellink and de la Cerda in press). Due to security reasons, we did not survey the river at a proper time of the day, but three individuals were detected on the mainstem of the river during the bird surveys.
- Beaver (*Castor canadensis*). This species was common in the area a few years ago (Mellink and Luevano 1998), and we recorded abundant signs of its presence at Pachuca 2 in our visit. Two individuals were detected during the bird surveys.

- Domestic dog. Scats and tracks at Pachuca 1. Adult and pup at Pachuca 2.
- Raccoon (*Procyon lotor*). Abundant tracks in dry mud at Pachuca 2.

Although the area lies within the distribution of the desert kangaroo rat (*Dipodomys deserti*), the patches of sandy habitat were too small for it, and no signs of its presence were found, nor was it trapped. The area is also within the distribution of the Colorado River delta subspecies of cotton rat (*Sigmodon hispidus eremicus*), a sensitive taxon. The area we explored lacked the thick herb cover required by the species.

There are a number of bat species of concern that occupy the general region, some of which could be found specifically in the area, but we could not survey for them, because of security reasons.

4.2.6 Alien Species

Other alien species (not listed in the above sections) that we recorded in the area were crawfish (*Procambarus*) and Asiatic clams (*Corbicula*).

4.3 Historic River Flows and Carrying Capacity

Instantaneous river flows measured at the Southerly International Boundary (south end of the Limitrophe) since 1980 are in Figure 5. Prior to 1980, flows were lower due to excess capacity first in Lake Mead, then in Lake Powell, as these reservoirs were filling. The flows of the early 1980's were exceptional. The peak flows of approximately 800 m³/sec in 1983 threatened the overflow spillways at Glen Canyon Dam and caused property damage along the river in the U.S., as well as lower in the delta near the junction of the Colorado River and Rio Hardy. These flows also caused property damage in the Limitrophe in Mexico, washing out several ha of agricultural fields and destroying several wells and pumps. As a result, the levees were raised to afford greater protection on both sides of the border. Figure 5 shows the design capacity of the levee system (installed after 1983), and an estimate of its current carrying

capacity, which has been reduced due to vegetation growth and siltation from 1993 releases of water and silt from the Gila River in the United States to the Colorado River. Even at an estimated half-capacity, the levee system appears to be able to convey flows at least double those of 1983. However, Mexico has fields within the levees which are still vulnerable to flooding. Finally, Figure 5 shows the capacity of a proposed pilot channel, which has been proposed to delineate the border between the United States and Mexico. This channel would capture nearly all of the small-event flows that have revegetated the floodplain with native trees.

5. CONCLUSIONS

The Limitrophe Zone of the Colorado River contains approximately 2700 ha of riparian habitat along the border between the U.S. and Mexico. Native trees and marsh habitat have regenerated in this river stretch due to the release of excess river flows from the United States to Mexico. In the northern part of the Limitrophe, below Morelos Dam, native trees represent 18% of the vegetation, more than on any other stretch of the Lower Colorado River. This regenerated habitat supports a diverse population of migratory and resident birds. Based on the rapid assessment conducted here, this river stretch is of very high regional importance in supporting terrestrial migratory birds, some of them listed as endangered in both the U.S. and Mexico. The Limitrophe is the narrowest portion of the Lower Colorado River, hence birds are funneled through this section in high density during migration.

The Limitrophe also supports reptiles, mammals and other wildlife. Although the area is now of some value to some species considered sensitive on one or the other side of the river (like beavers), this value could be enhanced by an aggressive management program. Just declaring the area protected will not be of any use. Restoring the area as a flowing river with a healthy riparian corridor should be considered. Eradication of the most aggressive alien species should also be examined, especially that of saltcedar, bullfrog and, perhaps, some of the fish. Reintroduction of Sonoran mud-turtle, garter snake and the native amphibians are all possible management goals. Management of habitat patches suitable for the cotton rat could also be of value.

Resource managers in the U.S. and Mexico are nearing a decision point about the future of the Limitrophe. On the one hand, the Cocopah and others have proposed that the riparian corridor receive some type of protection as a natural area for wildlife. On the other hand, IBWC has proposed to clear vegetation and channelize the river in this section. The present study documents the importance of the Limitrophe to wildlife, especially birds, and raises the question of whether altering the floodplain is necessary for flood control. Much more study and consideration is needed before these questions can be resolved. More thorough wildlife studies and a hydrological model including a risk analysis would help decision makers develop a plan for the future of this area.

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Table 1. Area and fractional cover of land cover classes in the Limitrophe of the Colorado River, based on aerial and satellite imagery acquired in June, 2002. The Limitrophe was divided into Upper and Lower sections for this analysis. The upper section is narrower than the lower

Land Cover Class	Area (ha)	%
Upper Limitrophe		
Area between levees	1329	100
Riparian corridor	716	53.9
Agriculture, roads	613	46.1
Water in River	33	4.6 (as % of rip. corridor)
Marshes in River	7.8	1.1 (as % of rip. corridor)
Bare Soil + Water	382	53.4 (as % of rip. corridor)
Terrestrial Vegetation	334	46.6 (as % of rip. corridor)
Shrubs	275	82.3 (as % of vegetation)
Native trees	59	17.7 (as % of vegetation)
Lower Limitrophe		
Area between levees	4869	100
Riparian corridor	2008	41.2
Agriculture, roads	2861	58.5
Water in River	66	3.2 (as % of rip. corridor)
Marshes in River	4	0.2 (as % of rip. corridor)
Bare Soil + Water	1188	59.2 (as % of rip. corridor)
Terrestrial Vegetation	820	40.7 (as % of rip. corridor)
Shrubs	904	97.4 (as % of vegetation)
Native trees	24	2.6 (as % of vegetation)

Notes:

Data were abstracted from GIS coverages of the Limitrophe by Reggie Romo and Pamela Nagler, Environmental Research Laboratory.

The area of native trees was determined by manually digitizing all cottonwood and willow canopies visible on the aerial photomosaic of the Limitrophe (0.5 m resolution). This method only counts trees greater than approximately 6 m height.

Shrubs include mainly saltcedar and arrowweed in approximately a 1:1 ratio, and some willow or cottonwood juvenile trees under 5 m height. A few screwbean mesquite trees were encountered in ground truth plots.

The shrub class was divided into 5 classes based on NDVI values, using an unsupervised classification. The fractional vegetation cover was determined from the mean NDVI value of each river stretch, using the regression equation, $y = (NDVI - 0.066)/0.309$ ($r = 0.81^{***}$).

Based on a paper in prepration, Nagler, Hinojosa, Romo and Glenn, 2003

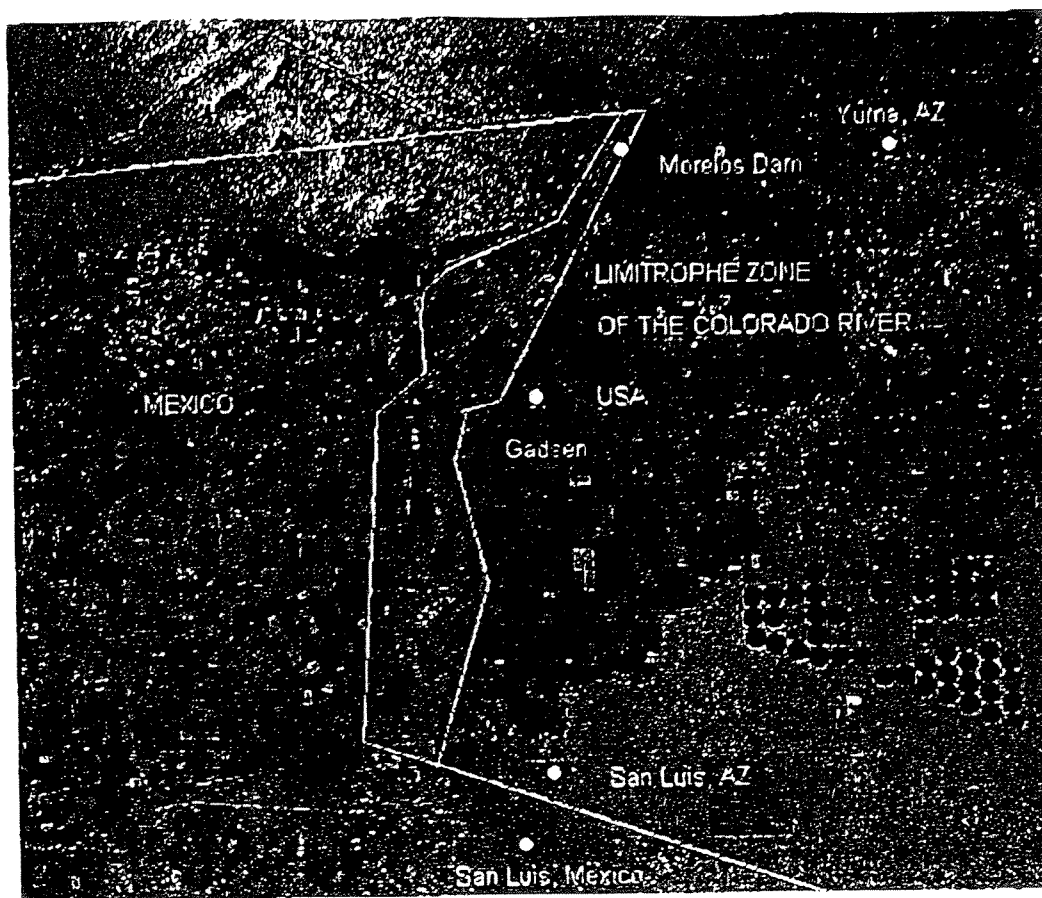


Figure 1. The Limitrophe Region of the Colorado River, from a June, 2002, ETM+ Satellite Image. The U.S. Mexico Border is defined by the river channel in this stretch.

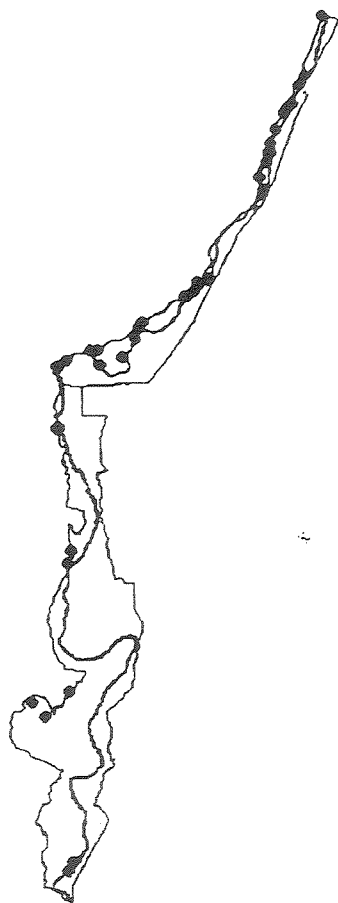


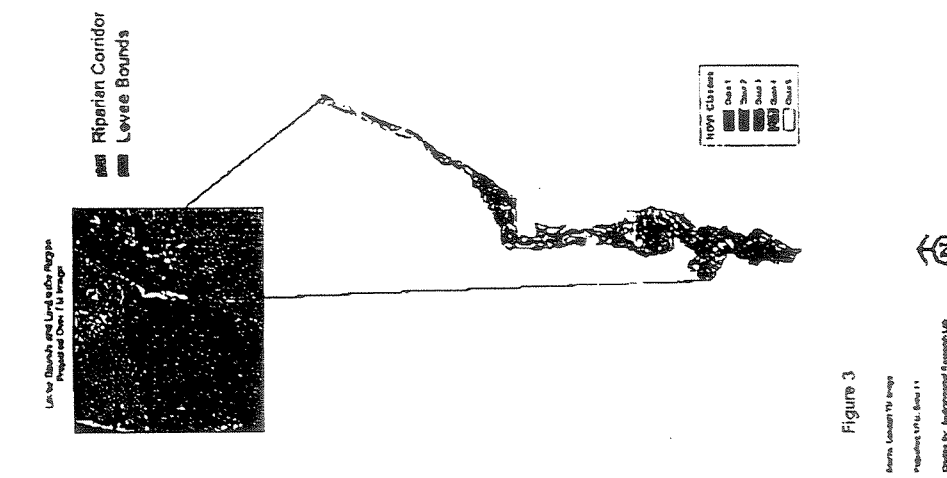
Figure 2. Location of bird and vegetation ground surveys in the Limitrophe.

Upper
Lower

5 Kilometers

Polygons based on NDVI Classes

- TREES
- MARSH
- RIVER
- NDVI Class
- 1
- 2
- 3
- 4
- 5
- 6



Bureau Location: NY 60-999
Investigator: W.F.M. Smith 11
Division by: Environmental Research Lab
Necessary all the time
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Flows of Colorado River at SIB, 1980-2002

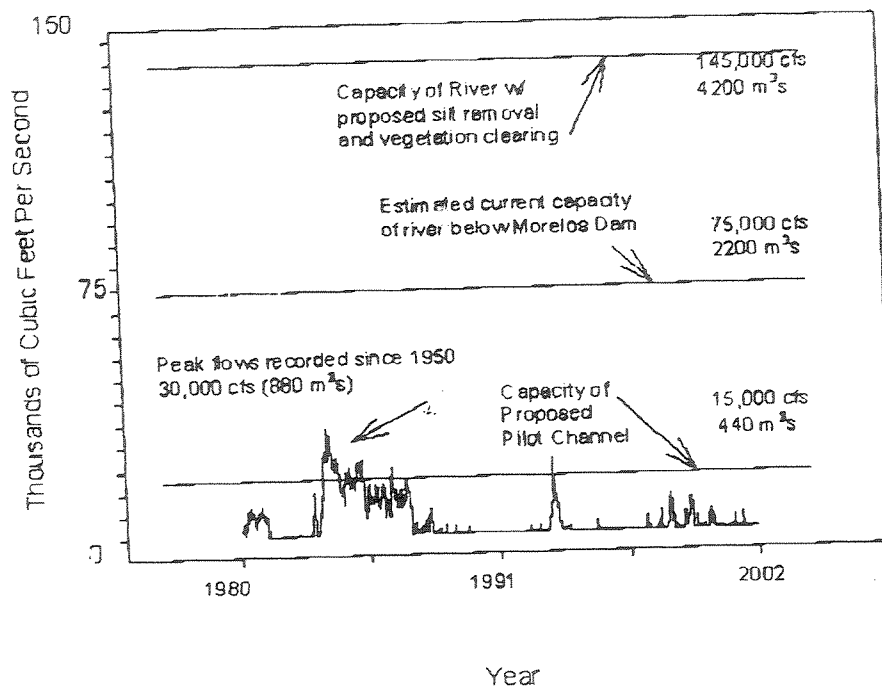


Figure 5. Flows and carrying capacity of the Colorado River through the Limitrophe Region.